Great Lakes Ice Cover Classification and Mapping Using Satellite Synthetic Aperture Radar (SAR) Data

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Owing to the size and extent of the Great Lakes and the variety of ice types and features found there, the timely and objective qualities inherent in computer processing of satellite data make it well suited for monitoring and mapping ice cover. However, during winter months cloud cover over the Great Lakes impairs the use of satellite imagery from passive sensors operating in the visible, near infrared, and thermal infrared regions and passive microwave data currently lacks the spatial resolution required for Great Lakes ice cover monitoring and analysis. The all-weather, day/night viewing capability of satellite Synthetic Aperture Radar (SAR) makes it a unique and valuable tool for Great Lakes ice identification and mapping providing that data analysis techniques can be developed. The European Remote-Sensing Satellite (ERS-1) SAR with vertical polarization launched in 1991 and more recently RADARSAT, an operational satellite carrying a SAR operating at 5.3 GHz (C-Band) with horizontal polarization launched in 1995, provide an opportunity for this development.

Using airborne and shipborne data as "ground truth", preliminary computer analysis of ERS-1 and RADARSAT ScanSAR narrow images of the Great Lakes using a supervised (level slicing) classification technique indicates that different ice types in the ice cover can be identified and mapped. During the 1997 winter season, shipborne polarimetric backscatter data were acquired using the Jet Propulsion Laboratory (JPL) C-band scatterometer, together with aerial reconnaissance data, surface-based ice physical characterization measurements, and environmental parameters, concurrently with RADARSAT and ERS-2 overpass. The scatterometer data set, composed of over 20 ice types or variations measured at incident angles from 0° to 60° for all polarizations, was processed to radar cross-section and establishes a library of signatures (look-up table) for different ice types to be used in the machine classification of calibrated satellite SAR data.

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